MULTIMEDIA UNIVERSITY®

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2016/2017

EMT1016 ENGINEERING MATHEMATICS I

(All Sections / Groups)

9 MARCH 2017
9.00 A.M – 11.00 A.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **3** pages including this cover page with **4** questions only.

2. Attempt all four questions. All questions carry equal marks and the distribution of marks for each question is given.

3. Print all answers in the answer booklet provided. Do show all relevant steps.

4. Programmable calculator is not allowed.

Question 1

(a) Evaluate the following limit:

(i) $\lim_{x\to\infty} \frac{2x^4 + x^3 - x^2 + 3}{6x^4}$. [2 marks]

(ii) $\lim_{x\to 4} \sqrt{\frac{x^2 - x - 12}{x^2 - 16}}$. [3 marks]

(b) Given that $2x^3 - 3y^2 = 9$. Show that $\frac{d^2y}{dx^2} = \frac{2x}{y} - \frac{x^4}{y^3}$. [5 marks]

(c) Find the given integrals:

(i) $\int 3x^2\left(x^3 + 60\right)^{60} dx$ by using substitution. [5 marks]

(ii) $\int e^{-x}(2 + x)dx$ by using integration by parts. [4 marks]

(d) Determine the local maximum and local minimum point(s) for $y = \frac{2x^3}{3} + \frac{x^2}{2} - 3x$. [6 marks]

Question 2

(a) Given $x^2 + 2y^2 + 3z^2 = 1$. Use implicit differentiation (via chain rule) to find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$. [5 marks]

(b) A function $f(x,y) = 1 + 4x - 5y$ is restricted by a closed triangular region with vertices $(0,0)$, $(2,0)$ and $(0,3)$. Find the absolute maximum and minimum values for $f(x,y)$. [10 marks]

(c) Use the method of Lagrange multipliers to find the maximum and minimum values of $f(x,y,z) = 2x + 6y + 10z$ given a constraint of $x^2 + y^2 + z^2 = 35$. [10 marks]

Continued ...

Question 3

(a) Find the open interval of convergence for $\sum_{n=1}^{\infty} \frac{(x-3)^n}{n^2}$ (neglect convergence or divergence at the endpoints). [6 marks]

(b) The Maclaurin series for $\sin(x)$ is given as follows:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \cdots + (-1)^n \frac{x^{2n+1}}{(2n+1)!} + \cdots, \text{ for all real } x.$$

Hence, or otherwise, find the Maclaurin series for the function $x\cos(2x)$ and its interval of convergence. [6 marks]

(c) Solve the equation $z^4 + 2\sqrt{3} = 2i$, and locate the solutions graphically in the complex plane. [13 marks]

Question 4

(a) Suppose that $f(x) = x^2$, for $0 \le x < 2$.

(i) Let $g(x)$ be the extended function of $f(x)$, where $g(x)$ has period 2. Sketch the graph of $g(x)$ on the interval $(-6, 6)$. [4 marks]

(ii) Let $h(x)$ be the extended **even** function of $f(x)$, where $h(x)$ has period **4**. Sketch the graph of $h(x)$ on the interval $(-6, 6)$. [4 marks]

(iii) To what values will the Fourier series of $g(x)$ and $h(x)$ converge at $x = 2$? [4 marks]

(b) A periodic function $f(x)$ of period 4 is defined by

$$f(x) = \begin{cases} 2 + x, & -2 < x \le 0, \\ 2 - x, & 0 < x \le 2. \end{cases}$$

Obtain the Fourier series for $f(x)$.

[13 marks]

End of Paper